

**BINDER STRIP CASSETTE****BACKGROUND OF THE INVENTION**5    1. Field of the Invention

The present invention relates generally to the field of bookbinding and, in particular, to container for dispensing adhesive binder strips.

10    2. Description of the Related Art

15              Binder strips having a paper substrate covered with a heat activated adhesive layer have become increasing popular for use in bookbinding. This method of bookbinding has become a low cost alternative to commercial bookbinding. An exemplary binder strip is disclosed in USPNo. 4,496,617, the contents of which are incorporated herein by reference. An exemplary desktop binding machine for binding books using the binder strips is disclosed in USPNo. 5,052,873, the contents of which are also incorporated herewith by reference. Referring to the drawings, Fig. 1 shows a binder strip 20 disposed adjacent the insertion point 30A of a conventional binding machine 30. A user 20 first places a stack of sheets 32 to be bound in an upper opening of the machine. Controls 30B are then activated to commence the binding process. The binding machine operates to sense the thickness of the stack 32 and indicates on a machine display 30C the width of binder strip 20 to be used. Typically, three widths can be used, including wide, medium and narrow. The 25 binder strip includes a flexible substrate 20A having a length that corresponds to the length of the edge of the stack 32 to be bound and a width somewhat greater than the thickness of the stack. A layer of heat-activated adhesive is disposed on one side of the substrate, including a low viscosity, low tack central adhesive band 20C and a pair of high viscosity, high tack outer adhesive bands 20B.

Once the user has selected a binder strip 20 of appropriate width, the user manually inserts the strip 20 into the strip loading port 30A of the machine. The end of the strip, which is positioned with the adhesive side up, is sensed by the machine and is drawing into the machine using an internal  
5 strip handling mechanism. The machine then operates to apply the strip to the edge of the stack to be bound. The strip is essentially folded around the edge of the stack, with heat and pressure being applied so as to activate the adhesive. Once the adhesive has cooled to some extent, the bound book is removed from the binding machine so that additional books can be bound.  
10 Fig. 2 depicts a partial end view of the bound stack 32. As can be seen, the binder strip substrate 20A is folded around the bound edge of the stack. The high tack, high viscosity outer adhesive bands 20B function to secure the strip to the front and back sheets of the stack. These sheets, which function as the front and rear covers, can be made of heavy paper or the like. The  
15 central low viscosity adhesive band 20C functions to secure the individual sheets of the stack by flowing up slightly between the sheets during the binding process.

Although manual feeding of the binder strip permits books to be bound at a fairly high rate, there is a need for an apparatus that can feed binder strips  
20 to binding machines at a higher rate. Such apparatus preferably could be used with a wide variety of binder machines and binder strips. Further, such apparatus would preferably be capable of storing a relatively large number of binder strips and be capable of fabrication using materials that are recyclable. As will be apparent from a reading of the following Detailed Description of the  
25 Invention together with the drawings, the present invention provides the above-described features.

SUMMARY OF THE INVENTION

- A binder strip cassette comprising a roll of binder strips rotatably mounted within a cassette housing is disclosed. The roll includes a multiplicity of elongated binder strips, with each of the binder strips including a flexible substrate and an adhesive disposed on the substrate. The roll further includes a flexible elongated carrier supporting the binder strips, with the binder strips being disposed along a length of the elongated carrier in an end-to-end arrangement.
- The cassette further includes a drive apparatus for unwinding the binder strip roll to provide an unwound portion of the binder strip roll. A separating apparatus is provided which is disposed within the cassette housing for separating the binder strips from the elongated carrier of the unwound portion of the binder strip roll to produce a separated binder strip, with the unwinding by the drive apparatus causing the separated binder strip to be at least partially ejected through a binder strip eject opening in the cassette housing. In one embodiment of the subject invention, the cassette includes apparatus for maintaining the unwound carrier and binder strips in contact with one another thereby reducing or eliminating the need for adhesives to secure the carrier and strips together.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 depicts prior art binding machine receiving a thermal adhesive binder strip.

5 Fig. 2 is a partial elevational side view of the edge of a stack of sheets bound by the Fig. 1 binding machine using the Fig. 1 binder strip.

Fig. 3 is an elevational view side view of a binder strip cassette in accordance with a first embodiment of the present invention.

10 Fig. 4 is a perspective view of the subject binder strip cassette showing the outer case.

Fig. 5 is a perspective view of the internal frame member of the subject binder strip cassette.

Fig 6 is an end view of the internal frame member of the subject binder strip cassette.

15 Fig. 7 is an end view of the subject binder strip cassette.

Figs 8A - 8C are schematic representations of a binder strip ejection sequence for the subject binder strip cassette.

Fig. 9 is a side elevational view of the take up roller of the subject binder strip cassette.

20 Figs. 10A - 10C are end views of the subject binder strip cassette showing the encoding present on the elongated carrier being displayed through an opening in the cassette housing.

Figs. 11A - 11D show various exemplary encoding indicia which can be used in connection with the subject binder strip cassette.

25 Fig. 12 is a table showing the manner in which the indicia of Figs 11A - 11D are decoded.

Figs. 13, 14 and 15 depict the subject binder strip cassette in combination with a prior art binding machine.

30 Figs 16A - 16B show one type of cassette holding apparatus for use in connection with the subject binder strip cassette.

Figs 17A - 17B show a second type of cassette holding apparatus for use in connection with the subject binder strip cassette.

Fig. 18 is a cut away perspective view of a binder strip cassette in accordance with the second embodiment of the subject invention.

Fig. 19 is a cut away elevational view of the second embodiment binder strip cassette.

5 Fig. 20 is an enlarged portion of Fig. 19 showing details of the primary guide of the cassette for guiding the binder strips and carrier.

Fig. 21 is a schematic representation comparing certain aspects of the first and second embodiments of the subject binder strip cassette.

10 Figs 22 and 23 are respective perspective and elevational views of the primary guide of the second embodiment binder strip cassette.

Fig. 24 is a cut away view showing a binder strip being ejected from the second embodiment binder strip cassette into a binding machine.

15 Figs 25A and 25B are cut away views of the second embodiment binder strip cassettes illustrating the pivoting of the binder strip primary guide as the binder strip roll is depleted.

Figs. 26 and 27 depict further examples of encoding patterns that can be incorporated into the elongated carriers.

DETAILED DESCRIPTION OF THE INVENTION

Referring again to the drawings, a first embodiment of the present invention, a binder strip cassette, is shown in Figs. 3, 4 and 5. The cassette, generally designated by the numeral 36, includes a roll 38 of individual adhesive binder strips 42 supported on a continuous elongated carrier 40. A very low tack adhesive is used to secure the substrate side of the strip to the carrier, with the strip being disposed on the inner surface of the carrier. One suitable adhesive for this application is type HL2268, from H.B. Fuller of St. Paul, Minnesota. In that the continuous carrier 40 is disposed on the exterior side of the roll, the carrier functions to hold the roll together. Roll 38 is rotatably mounted on a main roller 44, which is preferably made of heavy paper tubing. As shown in Fig. 5, the cassette includes an inner frame member 52, preferably manufactured from a single sheet of corrugated cardboard or other semi-rigid recyclable material. The inner frame member 52 is disposed within an outer case 50 as can be seen in Fig. 4. Case 50 is also preferably made of recyclable material, with a rigid paper such as 30-point chip board, being found suitable for the present application. Frame member 52 is preferably fabricated from a single sheet of material that is folded in two places to provide a pair of facing side members 52H and 52I as shown in Figs. 5 and 6 which are interconnected by web members 52B and 52C. Fig. 6 does not show the main roller 44 or the binder strip roll 38 for purposes of clarity.

A pair of openings (not designated) are formed in the opposite spaced-apart side members 52H and 52I of the frame member 52 to receive the main roller 44 of the binder strip roll 38. The spacing between the facing side members 52H and 52I of the frame member is equal to the width of the web members 52B and 52C of the frame and is also substantially equal to the width of the binder strip roll 38. The roll 38 thus contributes to the overall rigidity of the cassette until the roll is essentially completed. As will be described, another roller takes up the elongated carrier 40 so that the wound up carrier also contributes to the rigidity, particularly when the binder strip roll 38 is substantially depleted. Note that the thickness of the cassette is adjusted to conform to the width of the binder strips and associated elongated carrier 40.

The roller 44 is captured by the opposing inner surfaces of the outer case 50. An unwound portion 38A of the binder strip roll is guided to be proximate a binder strip ejection opening 50A formed in the outer case 50 by way of a rotatably mounted idler roller 46. Roller 46, which is also preferably made of heavy paper tubing, is rotatably mounted within opposing openings (not designated) in the frame member 52 and is also secured in place or captured by the inner surfaces of outer case 50.

The unrolled segment 38A of the binder strip roll 38 extends to edge 52J (Figs. 3 and 6) of web member 52B of the frame member. The elongated carrier 40 is then drawn around edge 52J and along the surface of the web member 52B. A pair of extensions 52A in the frame member 52 define a passage way between outer case 50 and web member 52B through which carrier 40 passes. The action of carrier 40 making a relatively sharp turn over edge 52J and down the face of web member 52B causes the carrier 40 and the leading edge of the individual binder strip 42A to begin to separate as shown in Fig. 3 thereby starting the binder strip ejection sequence. Figs 8A - 8C illustrate the complete ejection sequence, with the outer case 50 and frame member 52 not depicted. The somewhat rigid binder strip 42A will tend to continue moving in a linear path through the strip ejection opening 50A in cover 50 as can best be seen in Fig. 3 and in Fig. 4.

The underlying elongated carrier 40 is drawn through an opening 52K in the frame member intermediate web members 52B and 52C to a driven take up roller 48. The elongated carrier 40 is wound around take up roller 48, with roller 48 being rotatably driven through an access opening formed in cover 50 as shown in Fig. 4. Roller 48 is preferably made of heavy paper tubing and includes a pair on opposing cutouts 48A that can be used to key the roller to an external drive mechanism. In that roller 48 is not captured on both sides by outer case 50, roller 48 includes a center section 48B of exterior paper tubing to slightly increase the exterior diameter of the roller as shown in Fig. 9. The center section 48B has a diameter greater than the access opening in frame member 52 so that roller 48 will be captured between frame members 52H and

52I of the frame. Idler roller 46 can be identical to roller 48, including the presence of the non-functional cutouts, so as to reduce fabrication costs.

Referring to Fig. 8A, the binder strip 42A is shown approximately one-half way through the ejection sequence. Idler roller 46 functions to position 5 segment 38A relative to edge 52J to ensure that the underlying elongated carrier 40 will be forced to make the above-described sharp turn. Preferably, a guide member 50D (Fig. 3) is formed in outer case 50, which is positioned adjacent eject opening 50A and intermediate the two facing sides 52H and 52I of the frame member. Guide member 50D functions to control, to some 10 extent, the direction which the binder strip 42A takes exiting the cassette 36.

During the binder strip ejection sequence shown in Figs. 8A - 8C, the binder strip is being fed into the binding machine at a controlled rate. The state of the binder strip ejection sequence can be monitored by the binding machine 30 using encoded indicia present on elongated carrier 40. Preferably, 15 the encoded indicia are sensed by sensors disposed within a cassette holding apparatus to be described, with the sensor outputs being forwarded to the binding machine. The processing of the sensed indicia can be divided, as desired, between a controller present in the cassette holding apparatus and the controller of the binding machine 30. The encoded indicia can be printed on or 20 punched though selected locations on the carrier 40 since the position of the carrier correlates very well with the actual position of the binder strip 42A during ejection. Preferably, the encoded indicia is positioned on the face of the elongated carrier positioned adjacent the binder strip. By way of example, as 25 can be seen in Fig. 8A, indicia 54 is located on the surface of carrier 40 which is contacting the binder strip 42A.

As the strip continues in the ejection sequence, the indicia will eventually pass over edge 52J and down across web member 52B where the indicia is viewable through opening 50B (Fig. 7). In one instance, when an optical sensor on the binding machine detects the presence of the indicia 30 through opening 50B, the binder strip is essentially at the point where the strip is being separated from the carrier 40. At that point, the conventional binding machine 30 strip loading mechanism is free to complete loading of the strip by

drawing the strip into the binding machine. Further, the drive to take up roller 48 can be stopped so that no further binder strip feeding takes place while the binder is completing a binding operation. In this example, the there would be encoded indicia 54 for every binder strip on the binder strip roll 38, as will be  
5 further described in connection with Figs. 11A - 11D.

Encoded indicia can also be used to indicate that the binder strip roll 38 has almost been used up. In that case, the indicia would be placed on the carrier 40 near the end of the roll. Indicia performing differing functions can be distinguished from one another based upon the lateral location of the indicia  
10 on the carrier 40. In that event, two separate laterally spaced optical sensors A and B that are disposed external to the cassette on a cassette holding apparatus are used. By way of example, Fig. 10A shows a cassette 36 where the binder strip 42A is at the point of being released from the carrier 40 as also shown and described in connection with Fig. 8C. Indicia 54A on one side of  
15 carrier 40 is shown in opening 50A indicating the strip is at the release point. Fig. 10B shows another state of the binder strip roll 38I where indicia 54A again indicates that a binder strip 42A is being released. In addition, a second indicia 54B, laterally spaced from indicia 54A, is used to indicate that the roll is about completed, with only a few strips remaining. Indicia 54B is detected with the  
20 second sensor. Finally, Fig. 10C shows the roll when empty, with the first sensor detecting indicia 54A again indicating that the strip is being releases and with the second sensor detecting indicia 54C that the strip being released is the last strip on the roll. Indicia 54C is longer than indicia 54B so that the second sensor is able to determine that the indicia is indicating an end of roll rather  
25 than a near end of roll. A fourth condition not depicted exists when no indicia is present in opening 50A thereby indicating the a strip is in the middle of a feeding sequence.

Alternatively, indicia may be printed in more complex patterns similar to conventional bar codes. With a higher information density, the code may  
30 change throughout the roll 38 to indicate the number of strips remaining on the roll. Encoded indicia in the form of simple bar codes could also be used to identify the type of binder strip present in the cassette. A number of types of

bind can be done with thermal binder strips, including conventional strip-bind, perfectback binding and padding. In addition, there may be variations with special strip finishes and for binding specialized page stocks. Each bind type may require a different binder strip type that would be detected by the binding machine for proper operation. Additionally, indicia could identify the binder strip length, which will vary, for example, from 11 inches for standard letter size or 297 mm for standard A4 size. Further, the indicia could be used to identify the width, color or other characteristics of the binder strip.

Another possible application for the indicia is shown in Fig. 26. In this design, alternating low and high reflectivity marks having a uniform spacing L are printed along the length of the carrier 40. There is n number of marks for each binder strip 42. Alternatively, the carrier could be punched to produce a similar result. A controller can detect the rate at which the marks pass by opening 50B of the cassette and adjust the speed of the motor as needed.

This allows for velocity control without need for an additional tachometer system.

In yet another implementation, a repeating bar code may be printed or punched on carrier 40 as shown in Fig. 27. Because the bar code contains elements repeated with constant dimensions, the rate of the strip can be detected, as in the Fig. 26 implementation. In addition, other information can be readily encoded as desired using conventional bar coding techniques. The Fig. 27 implementation shows an exemplary pattern based on a constant module dimension M. Light bar 108A and dark bar 108B are both one module dimension M wide. Dark bar 108C is two module dimensions M wide and dark bar 108D is three module dimensions M wide. In this example, the bar 108D, which is three module dimensions M wide, serves as a divider between identical patterns R which are repeated three times (3R). Each of the patterns R is fourteen module dimensions M in length. The remainder of each of the repeating patterns encodes the desired detailed information and is comprised of an arrangement of dark bars that are one (108B) and two (108C) modules wide.

Certain other information regarding binder strip types can also be provided on the outer case 50. Printed encoded indicia can be applied to the case. Further, outer case 50 could include a selectable collapsible segment, such as segment 50C as shown in Fig. 4. That portion of the frame member 5 52 underlying segment 50C is provided with a notch 52E as shown in Fig. 5. This permits segment 50C to be selectively formed in the case 50. If, for example, A4 size binder strips are located in the cassette 36, the region of case 10 50 overlying notch 50C can be pressed inward to form an indentation which can be sensed by the binding machine using a sensing switch or the like. If, for example, 11-inch size binder strips are in the cassette, no notch is formed in the case 50. Parallel cuts can be formed in case 50 over notch 52E to facilitate 15 this process.

Fig. 11A shows of segment 38A of the binder strip roll 38. As previously described, the individual binder strips 42 are positioned along the length of the 15 elongated carrier 40, with the substrate of the strip contacting the carrier. Thus, the thermal adhesives on the strips are facing toward the center of the binder strip roll 38. A typical roll may contain 100 or more binder strips 42, this being a large number of strips relative to the overall size of the subject 20 binder strip cassette 36. This number can be increased significantly while maintaining a cassette size compatible with desktop binding machines. It is preferred that the strips be spaced a distance apart, such as distance X shown in Fig. 11A. Among other things, it has been found that when the strips and carrier are wound in roll form, the strips and carrier have a tendency to form wrinkles during the manufacturing process and over time. This is due to 25 relatively thick combination of carrier and strip thickness that resists being wound around a relatively small radius of curvature. To avoid such wrinkling, which can mar the appearance of the bound book, the spacing between the strips functions to provide a form of relief, so that the strips can move slightly relative to the overlying carrier. It has been found that a spacing X on the 30 individual strips should be at least 0.040 inches.

Typically, the binder strips are manufactured as a single long strip and then cut to the individual lengths. This can result in the production of debris

that needs to be removed. Preferably, the adhesive securing the strips 42 to the carrier 40 is not present in the regions near the ends of the strip adjacent spacing X so that the debris can be easily removed. This region Y where adhesive is absent from the leading edge of the binder strip is typically 0.06 to 5 0.25 inches in length. A similar region lacking adhesive is disposed at the trailing edge of the binder strip for the same purpose of facilitating debris removal. However, it is preferable, that the adhesive between the binder strips 42 and carrier 40 be absent in the region along length Z along the trailing end of the binder strip for reasons other than debris removal. This is because, 10 when the strip is driven in the direction indicated by arrow 56 over edge 52J (Figs. 3 and 6), as the strip begins to separate from the carrier 40, the strip extending out of the cassette will be captured by the strip transfer mechanism of the associated binding machine 30 and pulled into the machine. At this point, the binder strip drive function provided by carrier 40 is no longer needed 15 to eject the strip from the cassette. Thus, the adhesive is no longer needed to secure the strip to the carrier. The binder strip will then be essentially free of the carrier 40, so that the binder strip feed mechanism of the binding machine can continue to pull the strip out of the cassette at a rate somewhat greater than the rate at which the carrier 40 is driven to eject the strip from the 20 cassette. This reduces the degree to which the binder strip feed mechanism of the binder machine 30 needs to be synchronized with the drive to the take up roller 48. If an adhesive were present in region Z and if the binder strip feed mechanism were to take up the strip faster than it was being fed by the take up roller, the strip feed mechanism would advance the carrier at a rate faster 25 than roller 48 could take up the carrier 40. This would most likely cause the cassette mechanism to malfunction. Preferably, region Z, the region adjacent the trailing end of the strip, be free on adhesive. Region Z preferably comprises at least 20% of the total length of the binder strip.

As previously described, encoded indicia 54 can be used to provide 30 various information regarding the state of the subject binder strip cassette including the type of binder strip present in the cassette, the amount of binder strips remaining in the cassette and the location of the binder strips during

feeding of the strips into the binding machine. One approach is to use a pair of optical sensors A and B, shown schematically in Figs 11B through 11D, that are disposed within a cassette holding apparatus to be described. The sensors A and B are positioned along the path 56 taken by the elongated carrier 40 as  
5 the carrier passes by opening 50B of the cassette, and on opposite sides of the center axis of the carrier. Referring to Fig. 11B, the depicted indicia 54A on only one side of the path will be sensed by sensor A when that indicia passes by the sensor. There is an indicia 54A at this location for each of the binder strips 42 on the roll. There is no corresponding indicia on the other side of the  
10 axis, so that sensor B senses nothing when sensor A detects indicia 54A. These conditions indicate that the feeding of a binder strip into the binding machine is sufficiently completed such that the drive to the drive cassette take up roller 48 is to be stopped. This is also shown in the table of Fig. 12. When neither indicia being detected, the strip is in a strip feeding position as also  
15 shown in Fig. 12.

Fig. 11C shows exemplary indicia indicating the cassette is running low, with indicia 54A being repeated as in Fig. 11B and with an additional indicia 54B being added. This pair of indicia is positioned as shown for the last few strips on the roll. Detection of this condition, also shown in the table of Fig.  
20 12, can be used to cause a warning indication to be shown on the display 30C of the binding machine (Fig. 1) notifying the user that the cassette is almost empty. Indicia 54A of Fig. 11C further functions as a stop feed indication as previously described in connection with Fig. 11A. Finally, Fig. 11D, shows the  
25 indicia 54A and 54C indicating the last strip of the roll. Indicia 54C begins at the same location relative to the last strip as does indicia 54B of Fig. 11C and continues along the full length of the last binder strip and a substantial distance past the last strip. Indicia 54A terminates at the usual location thereby indicating that the strip feed has been completed. After a small additional drive, indicia 54A is no longer detected. Detection of this condition  
30 where sensor B detects indicia 54C and sensor A detects nothing can be used to display a further message on display 30C to the user, indicating that the cassette is empty. This condition is also shown in the table of Fig. 12.

The above-described indicia and the information provided by such indicia are intended to be exemplary only. Conventional bar codes and other more sophisticated encoding techniques could also be used to provide a greater range of information useful in the binding process. By way of example, 5 coding could be used to uniquely identify each strip of a roll so if a cassette is removed for some reason, such as to permit another cassette to be used, the replaced cassette can be readily recognized and the remaining number of binder strips displayed.

Fig. 14 depicts an exemplary cassette holding apparatus 58 for receiving 10 the subject cassette 36 and for interfacing the cassette with a prior art binding machine 30. Fig. 13 shows the orientation of the cassette 36 relative to binding machine achieved by the holding apparatus 58, with the holding apparatus itself not being depicted. The binder strip ejection opening 50A of the cassette is positioned opposite the binder strip input opening 30A of the 15 binding machine. Fig. 15 shows a cassette 36 inserted in the cassette holding apparatus 58, with the holding apparatus being positioned relative to the binding machine 30 for carrying out a binding operation. Figs 16A and 16B are cutaway views of the cassette holding apparatus 58 showing details of the apparatus construction. An electrical interface 70 is provided between the 20 holding apparatus 58 and the binding machine 30. An existing binding machine interface connector, used for controlling a conventional binder strip printer, can be readily adapted for this purpose. Among other things, the interface 70 can be used to provide power to the holding apparatus 58 and to provide control signal paths between the holding apparatus and the binding 25 machine. By way of example, interface 70 could carry information to be displayed by the binding machine based upon the indicia 54 indicating the cassette 36 is near empty.

The holding apparatus 58 includes a drive motor 72 which drives the cassette take up roller 48 through drive pulleys 74 and 76 and drive belt 78. 30 The previously described optical sensors A and B are positioned so that they are disposed opposite opening 50B and can sense the presence or absence of the indicia on the elongated carrier 40. Each sensor includes an optical

transmitter for illuminating the carrier 40 and an optical detector for detecting the reflected light, with the reflective light magnitude being indicative of the presence or absence of an indicia. Only sensor A is depicted for sensing indicia on one side of the carrier, with sensor B being positioned for sensing indicia on another side of the carrier and with sensor B being offset from sensor A as illustrated schematically in Figs. 11B through 11D.

Operation of the drive motor 72 is controlled by a suitably programmed micro-controller 64, primarily in response to the outputs of sensors A and B and control signals from the binding machine indicating that a binder strip is needed. The implementation of the micro-controller is straightforward and will not be described so as not to obscure the description of the invention in unnecessary detail. Basically, when the binding machine has started up or has completed a binding operation and is ready for a further binding operation, the binding machine 30 will send a command to the cassette holding apparatus 58 by way of interface 70 that a binder strip of a certain width is needed. If the cassette 36 contains a binder strip of incorrect width, the holding apparatus 58 will signal the binding machine that another cassette must be loaded in the holding apparatus. Assuming that cassette type is proper, micro-controller 64 can signal motor 72 to proceed to load a binder strip 42A into the binding machine. As can be seen in Fig. 16B, a binder strip is fed through the strip opening 50A of the cassette, with the strip being separated from the carrier 40 in the process. As also shown in Fig. 16B, the strip 42A exiting the cassette will pass through a strip exit port 68 of the holding apparatus into the strip input opening 30A of the binding machine. As the strip is being fed into the binding machine, the indicia 54 associated with the strip being loaded will pass by opening 50B so that the indicia can be sensed by sensors A and B. When sensor A senses an indicia 54A such as shown in Figs. 11B through 11C, the associated binder strip is essentially free of the underlying elongated carrier 40 so that micro-controller 64 can command the drive motor 74 to halt. The binder strip loading mechanism of the binding machine will have sensed the presence of the binder strip and will draw the remainder of the strip into the

binding machine. Once a binding operation is completed, the binding machine can then request a further binder strip. In the event that the cassette does not utilize encoding, optical sensors 62A and 62B can be used to detect the presence and absence of a binder strip disposed in the strip exit port 68 of the 5 cassette holding apparatus. Although this approach is not preferred, these optical sensors, together with the sensors located within the binding machine itself, will provide sufficient information to permit the micro-controller 64 to control the operation of the drive motor 74.

Figs 17A and 17B show an alternative arrangement for the cassette 10 holding apparatus which provides a further alternative to encoding the carrier 40 or strip 42 itself. A roller 80 is provided which is positioned to engage the elongated carrier 40 as the carrier passes by opening 50B. The roller 80 is biased against the carrier 40 by a spring mechanism (not depicted) so that linear movement of the carrier translates to rotational movement of the roller. 15 Roller 80, in turn, drives a conventional optical encoder 84 by way of a belt 82. By using a stepper motor or servomotor for the drive, the rotational speed of drive motor 72 is determined. Comparing the output of the encoder 84 to the speed of the drive motor indicates the diameter of the take-up roll 48 in the cassette. Given that the thickness of the carrier 40 is known, the diameter of 20 the take-up roller indicates the length of the carrier 40 that has been driven thereby providing sufficient information to ascertain the number of binder strips 42 remaining in the cassette. This information is processed by micro-controller 64 and forwarded to the binding machine for display and other possible action.

25 A second embodiment of the subject binder strip cassette 36 is shown in Figs. 18 and 19. One advantage of this embodiment over the first embodiment is that the need for an adhesive to secure the binder strips 42 to the elongated carrier 40 is reduced or eliminated altogether. The cassette includes a pivoting primary guide 88 which, as will be described in greater detail, functions to 30 deflect the normal path of the carrier 40 and binder strips 42 so as to slightly force the binder strip 42 in the process of being unwound against the overlying carrier 40. This force will tend to maintain the carrier 40 in contact with the

overlying binder strips 42 in the region between the point where the carrier 40 and strips 42 leave the roll 38 and where the separated strips 42A exit the cassette. Given the slight degree of tackiness of the carrier 40, this action is sufficient to substantially reduce or eliminate the need for an adhesive to  
5 secure the strips 42 to the carrier 40.

Fig. 21 is a schematic representation of the path taken by carrier/strip in the first embodiment cassette (Fig. 3) and the second embodiment cassette (Figs 18 and 19). The primary guide 88 is not shown in Fig. 21. As previously described, binder strip roll 38 includes an elongated carrier 40 which supports  
10 the individual binder strips 42. The roll 38 is formed so that the carrier 40 is disposed on the exterior of the roll. Thus, carrier 40 functions to secure the strips 42 in place when the strips are in roll form. When the roll is unwound, this compression force applied by the carrier 40 is no longer present. The carrier 40 and strips 42 of the first embodiment cassette will follow a path  
15 indicated by line 94 between a point C at binder strip roll 38 and point D at the idler roller 46, so that line 94 forms a tangent line with respect to the outer circumference of each of these elements. As a strip 42 comes off the roll 38, there is a tendency for the leading edge of the strip to separate from the carrier 40, especially if there is no adhesive present at this leading edge. The  
20 pivoting primary guide 88 of the second embodiment prevents this separation by causing the path taken by the carrier/binder strips to change from line 94 to line 98. The magnitude in the change in paths is somewhat exaggerated for purposes of illustration. The force applied to the binder strips 42 against the carrier 40 as a result of this path change functions to maintain the carrier in  
25 contact with the strips 42 as desired. As will be explained, this force can be well controlled and tends to be substantially independent of the amount of binder strips remaining on roll 38.

Referring again to Figs. 18 and 19, primary guide 88 can be seen, pivotally mounted on pivot mount 86. As can be seen in Figs. 22 and 23, pivot  
30 mount 86 is basically a paper tube much like idler roller 46 of the first embodiment cassette. Mount 86 is secured in corresponding openings in frame member 52 so that the mount can rotate in the openings. As was the case of

idler roller 46, outer case 50 extends over the frame openings and thus captures the mount 86 in place. Primary guide 88 is secured to the periphery of mount 86 by an adhesive 102 as can be seen in Fig. 23. Primary guide 88 includes an elongated main member 88A and a bent member 88B. Both 5 members 88A and 88B are made of recyclable materials such as cardboard. A thin contact member 88C made, for example, from a sheet of polyester plastic, is secured to the end of bent member 88B.

Fig. 20 is an expanded view of the region of the binder strip roll 38 of Fig. 19 where the roll is unwound. As can be seen, the outer edge of the thin 10 contact member 88C is disposed near the point where the binder strips 42 and overlying carrier 40 separate from the roll 38. The bent member 88B of the primary guide 88 is captured between the wound portion of the roll 38 and a short segment of the unwound portion of the roll. The force applied by the unrolled portion gently forces the bent portion 88B and the thin plastic contact 15 member 88C against the smooth surface of the carrier 40 still wound on the roll. The unwound portion of the roll passes over the outer surface 100 of the bent member 88B (Fig. 22) and of main member 88A of the primary guide 88 thereby directing the unwound portion along the non-linear path 98 shown in Fig. 21. The thin contact member 88C insures that the primary guide 88 does 20 not catch on the ends of the binder strips 42 passing over the primary guide. This action causes the binder strips 42 passing over surface 100 to be forced against the overlying carrier 40 thereby permitting the carrier to carry out the desired function of transporting the binder strips out of the cassette as shown in Fig. 24. Note that Fig. 24 also shows the cassette 36 positioned adjacent a 25 binding machine 30 (the cassette holding apparatus 58 is not shown) feeding a strip into a pair of pinch rollers 90A, 90B of the binding machine. The pinch rollers function to draw the binder strip 42A into the binding machine.

The geometry of the primary guide 88 and the location of the pivot mount 86 relative to the binder strip roll 38 will vary depending upon various 30 factors, including the desired amount of non-linearity of the path 98 (Fig. 21). If the non-linearity is too great, the resultant friction will cause the drive force applied to the take up roller 48 to be excessive. The geometry should also be

selected to ensure that the contact member 88C can engage the roll 38 even when the roll is substantially completely unwound. This is illustrated in Figs. 25A and 25B. In Fig. 25A, the roll 38 is substantially full, with contact member 88C contacting the roll as shown. In Fig. 25B, the roll is substantially depleted 5 thereby causing the captured primary guide 88 to pivot about the center of pivot mount 86 in the direction shown by arrow 104 so that the contact member 88C continues to engage the roll.

Thus, various embodiments of a binder strip cassette have been disclosed. Although these embodiments have been described in some detail, it 10 is to be understood that various changes can be made by those skilled in the art without departing from the spirit and scope of the present invention as defined by the appended claims.